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-Network Based Isotope Estimation with Simultaneous Curve Fitting

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Radioxenon is used to identify underground nuclear explosions by quantifying the amount and isotopic ratios of Xe-135, Xe-133, Xe-133m, and Xe-131m. Determining these concentrations requires knowledge of the detector performing the measurement and the accurate attribution of each measured decay. The current standard for estimating the activity concentration employs a beta/gamma coincidence histogram combined with 7 or 10 rectangular regions-of-interest (ROI). These ROI are specific to the detector type, based on the energy resolution and efficiency of the detector. We present an alternative method of count attribution which employs neural networks trained on simulated data to generate probabilistic assignment for each detected count. These networks are physics-informed and employ gaussian curve fitting to closely model the expected behavior of radiation detectors. This reduces the parameters (hundreds compared to hundreds of thousands in related work) and maintains explainability of the results. Our work demonstrates a method of incorporating machine learning into radioisotope detection that does not require faith in a black-box model.

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Promotional text

Application of physics-informed machine learning to the estimation of radionuclide concentration in noble gas detectors while preserving explainability.

Oral preference format

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